

Table of Contents

	<u>Page</u>
<u>TABLES</u>	VII
<u>FIGURES</u>	IX
ACRONYMS AND ABBREVIATIONS	X
1.0 INTRODUCTION	1
2.0 SUMMARY OF EMISSIONS FROM TOCDF AND CAMDS	3
2.1 SOURCES AT TOCDF	3
2.2 SOURCES AT CAMDS	4
2.3 ESTIMATION OF EMISSION RATES	4
3.0 EXPOSURE ASSESSMENT	8
3.1 EXPOSURE SETTING	8
3.2 EXPOSURE SCENARIOS	11
3.3 FATE, TRANSPORT, AND EXPOSURE PARAMETERS	12
3.3.1 Parameter Values for GB, VX, and Sulfur Mustard	12
3.3.2 Evaluation of Mutton and Goat’s Milk Pathways for the Subsistence Rancher ..	12
3.3.2.1 Ingestion of Mutton	12
3.3.2.2 Ingestion of Goat’s Milk	14
3.3.3 Climatic and Water Body Information	14
3.3.4 Modifications in the Procedures for the Risk Assessment	16
3.4 EVALUATION OF POLYCHLORINATED BIPHENYLS	18
3.5 EVALUATION OF DIOXINS	18
3.6 EVALUATION OF LEAD	19
3.7 EVALUATION OF CHROMIUM	19
3.8 EVALUATION OF MERCURY	19
4.0 RISK CHARACTERIZATION	20
4.1 ESTIMATION AND DESCRIPTION OF POTENTIAL RISKS AND HAZARDS	20
4.1.1 TOCDF Risks and Hazards from All COPCs	21
4.1.1.1 GB Campaign	22
4.1.1.2 VX Campaign	25
4.1.1.3 Sulfur Mustard Campaign	27
4.1.2 TOCDF Risks and Hazards from Detected COPCs Only	29
4.1.2.1 GB Campaign	30
4.1.2.2 VX Campaign	30
4.1.2.3 Sulfur Mustard Campaign	32
4.1.3 CAMDS Risks and Hazards	32
4.1.3.1 Subsistence Rancher Adult and Child Scenarios	33
4.1.3.2 Adult and Child Resident Scenarios	33
4.1.3.3 On-Site Worker Scenario	33
4.1.3.4 SunTen Water Skier Scenario	34
4.1.3.5 Rush Lake Adult and Child Recreationist Scenarios	34
4.1.3.6 Rainbow Reservoir Fisher Adult and Child Scenarios	35
4.1.4 Cumulative Risks and Hazards	35
4.1.4.1 Subsistence Rancher Adult and Child Scenarios	36
4.1.4.2 Adult and Child Resident Scenarios	36
4.1.4.3 On-Site Worker Scenario	36
4.1.4.4 SunTen Water Skier Scenario	37
4.1.4.5 Rush Lake Adult and Child Recreationist Scenarios	37
4.1.4.6 Rainbow Reservoir Fisher Adult and Child Scenarios	38
4.1.5 Evaluation of Mutton and Goat’s Milk Pathways for the Subsistence Rancher ..	39
4.1.6 Evaluation Of Subsistence Rancher Who Works At DCD	41

Table of Contents

	<u>Page</u>
4.1.7	Evaluation of Acute Inhalation Hazards 42
4.1.8	Evaluation of Polychlorinated Biphenyls 43
4.1.9	Evaluation of Dioxins 43
4.1.9.1	Evaluation of Proposed Dioxin Slope Factor..... 44
4.1.9.2	Noncancer Effects of Dioxins..... 44
4.1.9.3	Evaluation of Infant Breast Milk Pathway for Dioxins 45
4.1.9.4	Bromine and Sulfur Analogs of Dioxins 45
4.2	RISK CHARACTERIZATION FOR COPCS THAT EXCEED TARGET LEVELS.... 46
4.2.1	Characterization of Mercury Hazards..... 46
4.2.1.1	Mercury Source, Fate, and Transport 46
4.2.1.2	Potential Exposure Pathways for Mercury..... 47
4.2.1.3	Summary of Mercury Hazard Characterization 48
4.2.2	Characterization for Indeno(1,2,3-cd)pyrene and Dibenz(a,h)anthracene Risks . 49
4.2.2.1	Indeno(1,2,3-cd)pyrene and Dibenz(a,h)anthracene Sources 49
4.2.2.2	Indeno(1,2,3-cd)pyrene and Dibenz(a,h)anthracene Fate, Transport, and Exposure Pathways..... 49
4.2.2.3	Summary of Indeno(1,2,3-cd)pyrene and Dibenz(a,h)anthracene Hazard Characterization 51
4.2.3	Characterization of Di(n)octyl Phthalate (DNOP) Hazards..... 51
4.2.3.1	Di(n)octyl Phthalate Sources 51
4.2.3.2	Di(n)octyl Phthalate Fate, Transport, and Exposure Pathways 52
4.2.3.3	Summary of Di(n)octyl Phthalate Hazard Characterization 53
4.2.4	Characterization of Ethyl Methanesulfonate (EMS) Risks..... 53
4.2.4.1	EMS Sources 53
4.2.4.2	EMS Fate, Transport, and Exposure Pathways..... 53
4.2.4.3	Summary of EMS Risk Characterization..... 54
4.3	UNCERTAINTY ANALYSIS 54
4.3.1	Uncertainties Associated with Emission Rates..... 54
4.3.1.1	Non-Detected COPCs 54
4.3.1.2	Extrapolated Emission Rates 55
4.3.1.3	Total Organic Emission Rates 56
4.3.1.4	Metal Species..... 56
4.3.2	Uncertainties Associated with Exposure Assessment..... 56
4.3.3.1	Air Modeling 57
4.3.3.2	Fate and Transport 57
4.3.3.3	Exposure Parameters 57
4.3.3	Uncertainties Associated with Toxicity Assessment 58
4.3.3.1	CDC Toxicity Values 58
4.3.3.2	Route-to-Route Extrapolation..... 58
4.3.3.3	U.S. EPA Toxicity Value Uncertainties 58
4.3.3.4	Lack of Toxicity Values 59
4.3.4	Sensitivity Analysis on the Time Period of Combustion..... 59
5.0	REFERENCES 62

APPENDICES

NOTE: All appendices are available from the Division of Solid and Hazardous Waste (DSHW). Appendices B through S are also available in Portable Document Format (PDF) at the DSHW web site http://www.hazardouswaste.utah.gov/CDS/CDS_Risk_Page.html.

A MICROSOFT ACCESS DATABASE FOR TOCDF AND CAMDS HEALTH RISK ASSESSMENT

Table of Contents (Appendices Continued)

- B REVISED EMISSION RATE SPREADSHEETS FOR TOCDF AND CAMDS
- C WEIGHTED-AVERAGE EMISSION RATES FOR TOCDF
- D WORST-CASE EMISSION RATES FOR CAMDS
- E EMISSION RATES, TOXICITY EQUIVALENCY FACTORS, AND TOXICITY EQUIVALENTS FOR POLYCHLORINATED BIPHENYLS
- F IRAP-*h* View OUTPUT FILES FOR TOCDF GB CAMPAIGN
 - F-1 GB–Subsistence Rancher Scenario
 - F-2 GB–Resident Scenario
 - F-3 GB–On-Site Worker Scenario
 - F-4 GB–SunTen Water Skier Scenario
 - F-5 GB–Rush Lake Recreationist Scenario
 - F-6 GB–Rainbow Reservoir Fisher Scenario
- G IRAP-*h* View OUTPUT FILES FOR TOCDF VX CAMPAIGN
 - G-1 VX–Subsistence Rancher Scenario
 - G-2 VX–Resident Scenario
 - G-3 VX–On-Site Worker Scenario
 - G-4 VX–SunTen Water Skier Scenario
 - G-5 VX–Rush Lake Recreationist Scenario
 - G-6 VX–Rainbow Reservoir Fisher Scenario
- H IRAP-*h* View OUTPUT FILES FOR TOCDF SULFUR MUSTARD CAMPAIGN
 - H-1 Sulfur Mustard–Subsistence Rancher Scenario
 - H-2 Sulfur Mustard–Resident Scenario
 - H-3 Sulfur Mustard–On-Site Worker Scenario
 - H-4 Sulfur Mustard–SunTen Water Skier Scenario
 - H-5 Sulfur Mustard–Rush Lake Recreationist Scenario
 - H-6 Sulfur Mustard–Rainbow Reservoir Fisher Scenario
- I MICROSOFT ACCESS REPORT FOR TOCDF GB RISK BASED ON DETECTIONS ONLY
 - I-1 GB–Subsistence Rancher Scenario
 - I-2 GB–Resident Scenario
 - I-3 GB–On-Site Worker Scenario
 - I-4 GB–SunTen Water Skier Scenario
 - I-5 GB–Rush Lake Recreationist Scenario
 - I-6 GB–Rainbow Reservoir Fisher Scenario
- J MICROSOFT ACCESS REPORT FOR TOCDF VX RISK BASED ON DETECTIONS ONLY
 - I-1 VX–Subsistence Rancher Scenario
 - I-2 VX–Resident Scenario

Table of Contents (Appendices Continued)

- I-3 VX–On-Site Worker Scenario
- I-4 VX–SunTen Water Skier Scenario
- I-5 VX–Rush Lake Recreationist Scenario
- I-6 VX–Rainbow Reservoir Fisher Scenario

- K MICROSOFT ACCESS REPORT FOR TOCDF SULFUR MUSTARD RISK BASED ON DETECTIONS ONLY
 - K-1 Sulfur Mustard–Subsistence Rancher Scenario
 - K-2 Sulfur Mustard–Resident Scenario
 - K-3 Sulfur Mustard–On-Site Worker Scenario
 - K-4 Sulfur Mustard–SunTen Water Skier Scenario
 - K-5 Sulfur Mustard–Rush Lake Recreationist Scenario
 - K-6 Sulfur Mustard–Rainbow Reservoir Fisher Scenario

- L IRAP-*h* View OUTPUT FILES FOR CUMULATIVE RISK ASSESSMENT
 - L-1 Subsistence Rancher Scenario
 - L-2 Resident Scenario
 - L-3 On-Site Worker Scenario
 - L-4 SunTen Water Skier Scenario
 - L-5 Rush Lake Recreationist Scenario
 - L-6 Rainbow Reservoir Fisher Scenario

- M IRAP-*h* View OUTPUT FILES FOR INFANT BREAST MILK PATHWAY
 - M-1 Subsistence Rancher Scenario
 - M-2 Resident Scenario
 - M-3 On-Site Worker Scenario

- N IRAP-*h* View OUTPUT FILES FOR MEAT AND MILK PATHWAYS FOR TOCDF GB CAMPAIGN
 - N-1 Mutton COPC Concentrations
 - N-2 Beef COPC Concentrations
 - N-3 Pork COPC Concentrations
 - N-4 Poultry COPC Concentrations
 - N-5 Goat’s Milk COPC Concentrations
 - N-6 Cow’s Milk COPC Concentrations

- O IRAP-*h* View OUTPUT FILES FOR MEAT AND MILK PATHWAYS FOR TOCDF VX CAMPAIGN
 - O-1 Mutton COPC Concentrations
 - O-2 Beef COPC Concentrations
 - O-3 Pork COPC Concentrations
 - O-4 Poultry COPC Concentrations
 - O-5 Goat’s Milk COPC Concentrations

Table of Contents (Appendices Continued)

O-6	Cow's Milk COPC Concentrations
P	IRAP- <i>h</i> View OUTPUT FILES FOR MEAT AND MILK PATHWAYS FOR TOCDF SULFUR MUSTARD CAMPAIGN
P-1	Mutton COPC Concentrations
P-2	Beef COPC Concentrations
P-3	Pork COPC Concentrations
P-4	Poultry COPC Concentrations
P-5	Goat's Milk COPC Concentrations
P-6	Cow's Milk COPC Concentrations
Q	MICROSOFT ACCESS REPORTS FOR ACUTE INHALATION
Q-1	TOCDF GB–On-Site
Q-2	TOCDF GB–Off-Site
Q-3	TOCDF VX–On-Site
Q-4	TOCDF VX–Off-Site
Q-5	TOCDF Sulfur Mustard–On-Site
Q-6	TOCDF Sulfur Mustard–Off-Site
Q-7	Cumulative Risk–On-Site
Q-2	Cumulative Risk–Off-Site
R	MICROSOFT ACCESS REPORTS FOR DIOXIN RISKS
R-1	Subsistence Rancher Scenario
R-2	Resident Scenario
S	MICROSOFT ACCESS PROJECT FILES FOR LEAD HAZARDS
S-1	Lead Concentrations in On-Site Soil and Air
S-2	Lead Concentrations in Off-Site Soil and Air
T	IRAP- <i>h</i> View PROJECT FILES FOR TOCDF GB CAMPAIGN
T-1	Subsistence Rancher Scenario
T-2	Resident Scenario
T-3	On-Site Worker Scenario
T-4	SunTen Water Skier Scenario
T-5	Rush Lake Recreationist Scenario
T-6	Rainbow Reservoir Fisher Scenario
T-7	Mutton Ingestion Scenario
T-8	Goat's Milk Ingestion Scenario
U	IRAP- <i>h</i> View PROJECT FILES FOR TOCDF VX CAMPAIGN
U-1	Subsistence Rancher Scenario

Table of Contents (Appendices Continued)

U-2	Resident Scenario
U-3	On-Site Worker Scenario
U-4	SunTen Water Skier Scenario
U-5	Rush Lake Recreationist Scenario
U-6	Rainbow Reservoir Fisher Scenario
U-7	Mutton Ingestion Scenario
U-8	Goat's Milk Ingestion Scenario
V	IRAP- <i>h</i> View PROJECT FILES FOR TOCDF SULFUR MUSTARD CAMPAIGN
V-1	Subsistence Rancher Scenario
V-2	Resident Scenario
V-3	On-Site Worker Scenario
V-4	SunTen Water Skier Scenario
V-5	Rush Lake Recreationist Scenario
V-6	Rainbow Reservoir Fisher Scenario
V-7	Mutton Ingestion Scenario
V-8	Goat's Milk Ingestion Scenario
W	IRAP- <i>h</i> View PROJECT FILES FOR TOCDF AND CAMDS CUMULATIVE RISK ASSESSMENT
W-1	Subsistence Rancher Scenario
W-2	Resident Scenario
W-3	On-Site Worker Scenario
W-4	SunTen Water Skier Scenario
W-5	Rush Lake Recreationist Scenario
W-6	Rainbow Reservoir Fisher Scenario
X	Comments and Responses for the April 2002 Draft Health Risk Assessment

TABLES

<u>Table</u>	<u>Page</u>
TABLE 2-1	BASIS OF SOURCE-SPECIFIC EMISSION RATES 6
TABLE 3-1	FATE, TRANSPORT, AND TOXICITY PARAMETERS FOR GB, VX, AND SULFUR MUSTARD..... 13
TABLE 3-2	SITE-SPECIFIC CLIMATIC PARAMETERS 15
TABLE 3-3	WATER BODY PARAMETERS..... 15
TABLE 4-1	CANCER RISKS FOR TOCDF SOURCES THAT EXCEED DSHW REPORTING LEVEL FOR TREATMENT OF GB—ALL COPCs 24

Table of Contents (Tables Continued)

<u>Table</u>	<u>Page</u>
TABLE 4-2 HAZARD INDICES FOR TOCDF SOURCES THAT EXCEED DSHW REPORTING LEVEL FOR TREATMENT OF GB—ALL COPCs.....	25
TABLE 4-3 CANCER RISKS FOR TOCDF SOURCES THAT EXCEED DSHW REPORTING LEVEL FOR TREATMENT OF VX—ALL COPCs.....	26
TABLE 4-4 HAZARD INDICES FOR TOCDF SOURCES THAT EXCEED DSHW REPORTING LEVEL FOR TREATMENT OF VX—ALL COPCs	27
TABLE 4-5 CANCER RISKS FOR TOCDF SOURCES THAT EXCEED DSHW REPORTING LEVEL FOR TREATMENT OF SULFUR MUSTARD—ALL COPCs.....	28
TABLE 4-6 HAZARD INDICES FOR TOCDF SOURCES THAT EXCEED DSHW REPORTING LEVEL FOR TREATMENT OF SULFUR MUSTARD—ALL COPCS.....	29
TABLE 4-7 HAZARD INDICES FOR TOCDF SOURCES THAT EXCEED DSHW REPORTING LEVEL FOR TREATMENT OF GB—DETECTED COPCs ONLY.....	31
TABLE 4-8 HAZARD INDICES FOR TOCDF SOURCES THAT EXCEED DSHW REPORTING LEVEL FOR TREATMENT OF VX—DETECTED COPCs ONLY	31
TABLE 4-9 HAZARD INDICES FOR TOCDF SOURCES THAT EXCEED DSHW REPORTING LEVEL FOR TREATMENT OF SULFUR MUSTARD—DETECTED COPCs ONLY	32
TABLE 4-10 CANCER RISKS FOR CAMDS SOURCES THAT EXCEED THE DSHW REPORTING LEVEL.....	34
TABLE 4-11 HAZARD INDICES FOR CAMDS SOURCES THAT EXCEED THE DSHW REPORTING LEVEL.....	35
TABLE 4-12 CUMULATIVE CANCER RISKS AND HAZARD INDICES FOR SUBSISTENCE RANCHER ADULT AND CHILD SCENARIOS THAT EXCEED THE REPORTING LEVELS.....	37
TABLE 4-13 CUMULATIVE CANCER RISKS AND HAZARD INDICES FOR ADULT AND CHILD RESIDENT SCENARIOS THAT EXCEED THE REPORTING LEVELS.....	38
TABLE 4-14 CUMULATIVE CANCER RISKS AND HAZARD INDICES FOR ON-SITE WORKER SCENARIO THAT EXCEED THE REPORTING LEVELS	39
TABLE 4-15 CUMULATIVE HAZARD INDICES FOR ADULT AND CHILD RECREATIONIST SCENARIOS THAT EXCEED THE DSHW REPORTING LEVEL	40
TABLE 4-16 CUMULATIVE HAZARD INDICES FOR FISHER ADULT AND CHILD SCENARIOS THAT EXCEED THE DSHW REPORTING LEVEL.....	41
TABLE 4-17 COMPARISON OF CONCENTRATIONS OF COPCs IN MUTTON, BEEF, POULTRY, AND PORK	42

Table of Contents (Tables Continued)

<u>Table</u>	<u>Page</u>
TABLE 4-18 COMPARISON OF CONCENTRATIONS OF COPCs IN GOAT'S MILK AND COW'S MILK	42
TABLE 4-19 MAJOR UNCERTAINTIES IN TOCDF HEALTH RISK ASSESSMENT	47
TABLE 4-20 EFFECT ON THE TIME PERIOD OF COMBUSTION ON CANCER RISK	52
TABLE 4-21 THE EFFECT OF TIME PERIOD OF COMBUSTION ON HAZARD	52
TABLE 4-22 MERCURY MASS BALANCE FOR TOCDF GB CAMPAIGN	55

FIGURES

<u>Figure</u>	
3-1 SITE LOCATION MAP	9
3-2 LAND USE AND LAND COVER MAP	10
4-1 RECEPTOR LOCATIONS WITH MAXIMUM RISK OR HAZARD	23